Road Transportable Analytical Laboratory (RTAL) System

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Abstract

U.S. Department of Energy (DOE) facilities around the country have, over the years, become contaminated with radionuclides and a range of organic and inorganic wastes. Many of the DOE sites encompass large land areas and were originally sited in relatively unpopulated regions of the country to minimize risk to surrounding populations. In addition, wastes were sometimes disposed of underground at the sites in 55-gallon drums, wood boxes or other containers until final disposal methods could be determined. Over the years, these containers have deteriorated, releasing contaminants into the surrounding environment. This contamination has spread, in some cases polluting extensive areas.

Remediation of these sites requires extensive sampling to determine the extent of the contamination, to monitor clean-up and remediation progress, and for post-closure monitoring of facilities. The DOE would benefit greatly if it had reliable, road transportable, fully independent laboratory systems that could perform on-site a full range of analyses meeting high levels of quality assurance and control. Such systems would accelerate and thereby reduce the cost of clean-up and remediation efforts by (1) providing critical analytical data more rapidly, and (2) eliminating the handling, shipping and manpower associated with sample shipments.

The goals of the Road Transportable Analytical Laboratory (RTAL) Project are the development and demonstration of a system to meet the unique needs of the DOE for rapid, accurate analysis of a wide variety of hazardous and radioactive contaminants in soil, groundwater, and surface waters. This laboratory system is designed to provide the field and laboratory analytical equipment necessary to detect and quantify radionuclides, organics, heavy metals and other inorganic compounds. The laboratory system consists of a set of individual laboratory modules deployable independently or as an interconnected group to meet each DOE site's specific needs.

After evaluating the needs of the DOE field activities and investigating alternative system designs, the modules included in the RTAL system are:

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- Radioanalytical Laboratory
- Organic Chemical Analysis Laboratory
- Inorganic Chemical Analysis Laboratory
- Aquatic Biomonitoring Laboratory
- Field Analytical Laboratory
- Robotics Base Station
- Decontamination/Sample Screening Module
- Operations Control Center

The goal of this integrated laboratory system is a sample throughput of 20 samples per day, providing a full range of analyses on each sample within 16 hours (after sample preparation) with high accuracy and high quality assurance. This is much shorter than the standard 45 day turnaround time typical of commercial laboratories. In addition, shipping samples off-site is a time-consuming, paperwork-intensive process, leading to additional delays in sample analyses. The focused project support provided by the RTAL is designed to significantly accelerate critical remediation and site closure projects.

A prototype RTAL system was constructed for demonstration at the DOE's Fernald Environmental Management Project (FEMP). It was deployed at FEMP's OU-1 Waste Pits. Its performance was evaluated with samples from these pits and with other environmental samples from the FEMP site. The prototype RTAL system consists of 5 modules - Radioanalytical Laboratory, Organic Chemical Analysis Laboratory, Inorganic Chemical Analysis Laboratory, Aquatic Biomonitoring Laboratory, and Operations Control Center. The U.S. Army Biomedical R&D Laboratory has volunteered to provide the Inorganic Chemical Analysis Laboratory and Aquatic Biomonitoring Laboratory as part of its concurrent demonstration of Integrated Biological Assessment (IBA) technology. The demonstration of the prototype RTAL took place during the 1st - 3rd Quarters of FY96 (including the Blizzard of ‘96). All performance and operational goals were met or exceeded. The prototype RTAL met the same performance and quality control/quality assurance standards as a well-equipped and well-run central laboratory. It exceeded sample throughput goals, generating a minimum of 21 and as many as 50 sample analyses per day, depending on the procedure. In addition, the RTAL’s sample turnaround times were 50-67% less than FEMP’s best times and RTAL costs were projected to be 30% less than FEMP costs for large volume analyses in fixed laboratories.

The RTAL will provide the DOE with significant time and cost savings, accelerating and improving the efficiency of clean-up, remediation and site closure projects throughout the DOE complex. At the same time, the system will provide full protection for operating personnel and ensure optimum performance of state-of-the-art analytical equipment.

Introduction

DOE facilities around the country have, over the years, become contaminated with radionuclides and a range of organic and inorganic wastes. Many of the DOE sites encompass

large land areas and were originally sited in relatively unpopulated regions of the country to minimize risk to surrounding populations. In addition, many times wastes were disposed of underground at the sites in 55-gallon drums, wood boxes or other containers until final disposal methods could be determined. Over the years, these containers have deteriorated, releasing contaminants into the surrounding environment. This contamination has spread, in some cases polluting extensive areas.

Remediation of these sites requires extensive sampling to determine the range of the contamination, to monitor clean-up and remediation progress, and for post-closure monitoring of facilities. Transporting these samples to a central laboratory, especially to one off-site, requires wipe tests for surface contamination before shipment and after receipt, specialized transportation containers and procedures (depending on the level of radioactivity present in the sample), and a substantial amount of additional paperwork. It can be very difficult and time-consuming to ship samples off-site from DOE facilities because of requirements established to ensure against inadvertent release of radioactive materials. The occasional improper shipment of radioactive materials from DOE facilities has led to periodic curtailment of all shipments to ensure that proper shipping procedures are followed. Such curtailments can cause havoc to projects where accurate and timely sample analytical data is critical to decision-making and also because environmental samples degrade over time.

The DOE would benefit greatly from the use of reliable, road transportable, fully independent laboratory systems that could perform the full range of analyses (with high quality assurance and control) required on-site. By focusing on high priority problems, such systems would accelerate clean-up and remediation efforts. They would provide critical high quality analytical data more rapidly, and save money by eliminating handling, shipping and manpower costs associated with sample shipments.

The RTAL developed for the DOE is based on the earlier laboratories and operations control centers developed by Engineering Computer Optecnomics (ECO), Inc. for the U.S. Environmental Protection Agency, and the U.S. Departments of Defense and State. These include counter-terrorist systems for use in areas contaminated with chemical or biological warfare agents. The advances achieved in the development of these earlier systems have been incorporated into the development of the RTAL.

Objective

The Road Transportable Analytical Laboratory (RTAL) Project covers the development and demonstration of a system to meet unique DOE needs for rapid, accurate analysis of a wide variety of hazardous and radioactive contaminants in soil, groundwater, and surface waters. This laboratory system is designed to provide the analytical equipment necessary to detect and quantify radionuclides, organics, heavy metals and other inorganics. The laboratory system consists of a set of individual laboratory modules deployable independently or as an interconnected group to meet each DOE site's specific needs.

The goal of the integrated laboratory system is a sample throughput of 20 samples per day, providing a full range of analyses on each sample within 16 hours (after sample preparation) with high accuracy and high quality assurance. This is much shorter than the standard 45 day turnaround time typical of commercial laboratories. In addition, shipping of samples off-site is a time-consuming, paperwork-intensive process, leading to additional delays in sample analyses. This focused attention on high priority needs can accelerate and improve the efficiency of clean-up and remediation operations. The RTAL will be synergistic with existing analytical laboratory capabilities by reducing the occurrence of unplanned "rush" samples which are disruptive to efficient laboratory operations.

Project Description and Results

To meet the wide range of environmental analytical requirements at the DOE's facilities while retaining the flexibility for rapid, cost-efficient response, the RTAL was conceived as a series of individual modules that could be deployed individually or as an integrated group. After evaluating the needs of the DOE field activities and investigating alternative system designs, the modules to be included in the full RTAL are:

- Radioanalytical Laboratory
- Organic Chemical Analysis Laboratory
- Inorganic Chemical Analysis Laboratory
- Aquatic Biomonitoring Laboratory
- Field Analytical Laboratory
- Robotics Base Station
- Decontamination/Sample Screening Module
- Operations Control Center

Each module provides full protection for operators and equipment against radioactive particulates and conventional environmental contaminants. This is especially important in areas where radioactive particulates from environmental matrices, e.g. soils, are aerosolized by wind or volatile chemicals are present. These contaminants can adversely affect sensitive chemical and radiochemical analyses as well as being potentially harmful to personnel.

Each module has the following features to ensure optimal performance of sensitive state-of-the-art analytical instrumentation and reliable, independent operation:

- Shock and vibration protected for road transport
- No Department of Transportation restrictions
- HEPA filtration of incoming and exhaust air
- Integral electrical generation system providing filtered power
- Uninterruptible power supply
- Heating, ventilation and air conditioning (HVAC) system capable of handling wide range of outside temperatures and humidities

- Controlled air flow from "clean" to "dirty" areas
- Insulation in walls, floor and roof
- Integral fuel tanks
- Rugged, redundant design for maximum availability
- Hardened equipment for maximum reliability
- Designed for long life
- Designed for minimum acquisition and maintenance costs
- Designed for ease of repair and maintenance
- Designed for ease of exterior decontamination
- Innocuous appearance to minimize public apprehension during transport and deployment

The continuous supply of electricity is critical to the reliability of the tests being performed. The loss of power would shut down the analytical equipment and support and control systems, critical for maintaining controlled experimental conditions. For this reason, an automatic switching circuit is provided for use when operating from an external power source. If the external power source fails, this circuit automatically starts the laboratory's electrical generator and switches all systems to this independent source of power, thus ensuring maintenance of experimental conditions.

Each module is housed in a standard 48 foot long by 8½ foot wide trailer to facilitate transport to the test sites. These units have no Department of Transportation restrictions on road transport. Wider trailers are considered "wide loads" which must have vehicular escorts, can not travel all roads, and must pay road use fees in most states. These restrictions limit the adaptability of extra-wide systems to meet the changing requirements across the DOE complex and adds significantly to their operating costs.

The arrangement of the full set of RTAL modules closely follows the steps the samples and operating personnel will take and is consistent with the principle of As Low As Reasonably Achieveable (ALARA). The module closest to the contaminated area is the Decontamination/ Sample Screening Module. This module is divided into two halves. The decontamination side is used to decontaminate personnel in protective gear who have been collecting samples or performing other duties in contaminated areas. The other side of the module is for screening of collected samples. Personnel, in appropriate protective gear, bring the samples to the sample pass-through (located on the side of the module closest to the contaminated area). The samples are passed directly into the hot cell inside the Sample Screening side of the module. The samples are screened for radiation level to determine handling requirements during subsequent testing. They are also subdivided for the analyses to follow.

The next modules behind the Decontamination/Sample Screening Module are the Robotics Base Station and the Field Analytical Laboratory. These modules provide robotically operated and hand-carried instrumentation for field determination of radioactive and chemical contamination levels. These modules are needed for initial mapping of large areas. The robotic systems, in particular, would include automated geographic positioning equipment to fix the location of each measurement. All data is transmitted to the computer in the Robotic Base

Station for computerized mapping. The data provided by the robotic and field analytical systems would not meet the same high quality assurance and quality control standards as the samples analyzed in the RTAL modules. However, the data are very useful in determining the location of "hot spots," i.e. areas where personnel require protective ensembles.

The next set of modules are the four laboratories which are the heart of the RTAL system. These are the Radioanalytical, the Organic Chemical Analysis, the Inorganic Chemical Analysis, and the Aquatic Biomonitoring Laboratories. The subdivided samples from the Decontamination/ Sample Screening Module are analyzed for specific analytes in the first three laboratories. The Aquatic Biomonitoring Laboratory is used for broad screening of hazardous contamination (radiological or chemical) using fish and amphibians as test organisms. Aquatic biomonitoring tests are used to detect the presence of ultra-low trace levels of contamination, i.e. below standard detection levels for specific analytes, and analytes for which there is no test. It can also be used to determine the absence of contaminants, providing a means for determining whether an environmental matrix is "clean."

The next module is the Operations Control Center, which serves as the coordinating "brain" for all RTAL operations. The entrance to the Operations Control Center provides a portal monitor for all personnel leaving the laboratory area. Even though great care will be taken to ensure that all personnel handling samples remain uncontaminated, a final check is important to ensure that there is no inadvertent contamination as a result of operations conducted within the RTAL area. If contamination is detected, a decontamination shower is located in this module adjacent to the frisking station.

This RTAL system configuration divides the overall area into three contamination zones. The first zone is the contaminated area where radioactive and chemical contaminants are expected. The second zone is the laboratory modules where contaminated samples are handled in hoods, on bench tops, and in the analytical equipment. Although these areas are designed to contain contaminants, there is always a small risk of inadvertent release. The third zone is the contaminant-free zone beyond the portal monitor in the Operations Control Center.

Personnel and samples exiting the contaminated zone must go through the Decontamination/Sample Screening Module. This ensures that the only contamination entering the second zone is contained within the samples. All personnel exiting the second zone must go through the Operations Control Center frisking station to ensure they are contaminant-free. This arrangement minimizes contaminant risks for all personnel, both within and outside the RTAL area.

The RTAL incorporates cellular communications and, if desired, satellite communications. STU-III encryption devices for secure communications can also be added.

The RTAL computers are interconnected in a wireless Local Area Network (LAN). Appropriate software is included so that the computer systems within the RTAL complex can be monitored and controlled from the Operations Control Center or any of the other modules. This

greatly enhances the efficiency of the operation and minimizes personnel requirements for operating the complex and performing the analyses.

The RTAL provides the DOE with significant savings in terms of time and cost. Samples will be analyzed within days as opposed to the 45 day turnaround typical of commercial laboratories. In addition, off-site sample shipments will be minimized, saving additional time and manpower. Preliminary estimates indicate that the focused, integrated approach provided by the RTAL can provide significant savings to the DOE. More importantly, the RTAL's rapid, high quality data response will accelerate and improve the efficiency of clean-up and remediation operations throughout the DOE complex, resulting in major reductions in program costs. A prototype RTAL system was constructed and delivered to the DOE's Fernald Environmental Management Project (FEMP) for demonstration. It was deployed at FEMP's OU-1 Waste Pits. Its performance was evaluated with samples from these pits and with other environmental samples from the FEMP site. The prototype RTAL system consists of 5 modules - Radioanalytical Laboratory, Organic Chemical Analysis Laboratory, Inorganic Chemical Analysis Laboratory, Aquatic Biomonitoring Laboratory, and Operations Control Center. The Radioanalytical Laboratory houses two Germanium Detectors (weighing 5,000 lb. each), 24 Alpha Spectrometers, a Liquid Scintillation Counter, and a Gross Alpha/Beta Counter. The Organic Chemical Analysis Laboratory houses a Gas Chromatograph (GC)/Mass Spectrometer (MS), Purge and Trap GC/MS, GC with Flame Ionization Detector, automated Liquid/Liquid Extractor, automated Solid/Liquid Extractor, Size Exclusion Chromatograph, and Toxicity Characteristic Leachate Procedure (TCLP) Apparatus. Each laboratory also houses a sample preparation area (with hoods) in a separate room. The U.S. Army Biomedical R&D Laboratory has volunteered to provide the Inorganic Chemical Analysis Laboratory and Aquatic Biomonitoring Laboratory as part of its concurrent demonstration of Integrated Biological Assessment (IBA) technology.

The demonstration of the prototype RTAL was conducted during 1st - 3rd Quarters of FY96. The units operated independently, using their onboard generators to provide electricity, and onboard water supply and wastewater tanks. The prototype RTAL operated without any umbilicals during the entire period of the demonstration, including through the “Blizzard of ‘96.” The cold temperatures and intense snow did not degrade the performance of the laboratories or their analytical equipment. Thus, it was a most challenging demonstration of the system's ability to operate independently for extended periods.

The following analytical procedures were evaluated during the demonstration of the prototype RTAL:

- Volatile organic analysis (VOA)
- Semi-volatile analysis (SVOA)
- Toxicity Characteristic Leachate Procedure (TCLP)
- Heavy metals analysis
- Total uranium concentration
- Isotopic uranium concentration
- Automated liquid-liquid extraction
- Automated sample concentration

The radioanalyses focused on total and isotopic quantification of uranium in water and soil samples since that is the radiological contaminant of concern in FEMP's environmental samples. Both soil and aqueous samples were included in the studies. Some samples were prepared surrogates, others were actual environmental samples collected at FEMP. Samples containing mixtures of unknown contaminants were provided by FEMP personnel for the RTAL analysts to characterize qualitatively and quantitatively. Accurate records were maintained of all operations in the laboratories. Turnaround times were determined by the time from receipt of samples to delivery of complete analytical reports.

The VOA and SVOA analyses were performed in accordance EPA SW-846 Methods 8260 and 8270, respectively (modified only to allow for safe handling of radioactive samples). These are the methods used by FEMP for their VOA and SVOA analyses. TCLP extractions were performed in accordance with EPA SW-846 Method 1311 (the same procedure used by FEMP). Heavy metals analyses were performed by Inductively Coupled Plasma (ICP) spectroscopy. The uranium isotopic analysis followed the procedure used by FEMP. Chemical dissolution of the samples was followed by purification. The purified samples were then deposited onto a substrate which was then counted by alpha spectrometry. The chemical yield was determined using U-232 as a tracer. The sensitivity of this method is a function of the count time. Thus, sensitivity can be improved by increasing the count time, the only limitation being the background count level.

At the conclusion of the demonstration, operating personnel stowed all equipment, cleaned the interior of the RTAL modules, drained all water tanks, and changed the oil. This close-down procedure required 1.5 days. It is the same preparation required to prepare the RTAL for transport to another site. Upon arrival at another site, the analytical equipment would require system check-out and calibration prior to initiation of formal analyses.

RTAL Performance

In all cases, the analyses performed in the RTAL were in excellent agreement with the FEMP analyses from conventional laboratories - all contaminants of concern were identified at the correct concentrations. Turnaround times ranged from 1 day for the VOA samples to 3.5 days for the TCLP Semi-volatile samples (including sample preparation, report preparation and record keeping). Sample throughput of 7 samples per 8-hour shift (equating to 21 samples per day) was achieved. In all cases, the goal of completing all analyses within 16 hours after sample preparation was achieved. Excellent quality control was maintained throughout the evaluation tests. FEMP personnel were very impressed with the capabilities of the labs and their results.

FEMP Chain of Custody forms were maintained for all samples. These were used to determine the time the samples were introduced into each laboratory for analysis. Turnaround times were determined from the time of sample introduction to the time the reports of analytical results were provided to FEMP project staff. Reports included sample identification numbers, analytical results, and Quality Control sample results. The complete data package included all

raw and supporting data. FEMP Quality Assurance staff performed surveillance during sample preparation and analyses to ensure compliance with documented analytical, quality control and assurance, and safety procedures.

During the course of the field demonstration, FEMP Quality Assurance personnel performed an assessment of compliance to the prescribed analytical methodology. Surveillance of all of the analytical activities were performed concurrent with sample preparation and analysis activities. The analytical functions performed were evaluated for adherence to the prescribed method or procedure, proper sample preparation techniques, proper instrument calibration, and proper documentation maintenance. The documented results of this extensive surveillance confirmed strict adherence to proper methodology.

This evaluation is crucial since the RTAL laboratories will be used, in many cases, to supplement or replace fixed laboratory services. As a result, data comparability is a key issue when using the data generated in the RTAL modules for decision-making. This demonstration of the RTAL laboratories' ability to adhere to standard fixed laboratory standards allows the RTAL modules to be used to generate data which will be comparable to that obtained from fixed facilities.

FEMP project staff evaluated the accuracy and precision of the analyses performed in the RTAL. This evaluation is crucial to ensure data comparability with fixed laboratories. FEMP personnel found the RTAL laboratories adhered to the same quality control and assurance standards as fixed laboratories, generating data of equivalent quality.

One of the main advantages of the RTAL is its ability to perform high quality analyses on site with very fast turnaround times. Turnaround times were calculated as the time from sample delivery to the RTAL laboratories to report delivery to FEMP staff.

The sample turnaround times achieved by the RTAL are listed in Table 1. Typical and best turnaround times at laboratories used by FEMP are also listed for comparison. FEMP performs radioanalytical and inorganic analyses on-site and uses off-site laboratories for organic analyses. Off-site commercial laboratories typically have 21-45 day turnaround times. Table 1 clearly demonstrates that the RTAL's turnaround times were 1/3 to 1/2 of FEMP's and less than 1/10 those of a typical commercial laboratory.

The RTAL's short turnaround times are the result of its effective layout which maximizes operator efficiency and its incorporation of automated equipment. For example, the Semi-Volatile Organic Analyses benefitted from the automated liquid-liquid extractor installed in the Organic Chemical Analysis Laboratory's Sample Preparation Room. This cut the normal 36 hour extraction used at FEMP down to 6 hours.

In addition, the location of the RTAL near an active project site is important in minimizing the overall turnaround time. FEMP personnel estimate the location of the RTAL near project activities cuts up to an additional 3 days off sample transport and introduction into the laboratory. These steps are effectively eliminated using the RTAL. Moreover, the dedication of the RTAL to

Table 1

SAMPLE TURNAROUND TIMES
(Sample Receipt to Report Delivery)

	Turnaround Time, Days		
Procedure	RTAL	FEMP Best	FEMP Typical
VOA	1	7	7 - 14
TCLP-VOA	1.75	7	7 - 14
SVOA	2	7	7 - 14
TCLP-SVOA	3.5	7	7 - 14
Isotopic + Total U	3[a]	5[b]	5 - 10
RCRA Metals	<1	7	7 - 14

Notes:
a. Without soil muffling step which is not performed by FEMP
b. Performed by FEMP central lab; outside lab used for organic and RCRA metals analyses

a single project eliminates scheduling and capacity problems that slow down the performance of fixed laboratories.

All the chemists in the RTAL laboratories had typical experience of 3-5 years performing environmental analyses. None of the chemists received special training in the operation of the instrumentation in the RTAL laboratories. Thus, these turnaround times and the analytical performance (accuracy and prescision) discussed earlier should be achievable by chemists with average experience. This performance supports the contention that the RTAL laboratories are the equivalent of a well-designed and well-operated fixed laboratory.

ECO has been a strong proponent of high performance on-site laboratories as a way to lower sample analysis costs and reduce turnaround time while maintaining the highest levels of quality assurance and control. Shorter turnaround times also result in major project savings since the rapid availability of high quality data allows critical decisions to be made quickly, accelerating the overall project. The savings achieved through project acceleration can be very dramatic since expensive clean-up teams and equipment will be operating more efficiently.

FEMP personnel provided current costs (based on a standard 21 days turnaround time) for the environmental analyses performed in the RTAL during its evaluation at that facility. These costs are based actual costs for analyzing samples required for FEMP's National Pollutant Discharge Elimination System (NPDES) permit. FEMP analyzes a large number of these samples annually and these prices are discounted in consideration of the sample volume.

Costs for performing these sample analyses in the RTAL were calculated based on data obtained during the demonstration. A daily throughput of 21 samples each for volatile organics, semi-volatile organics, TCLP-volatile organics, TCLP-semi-volatile organics, TCLP-RCRA metals, and 50 samples for RCRA metals was assumed. This schedule was maintained for 240 days per year (5 days per week for 48 weeks). The 240 day per year schedule allows for federal holidays, down-time for equipment maintenance, and days when samples are not collected. Based on these assumptions, the current FEMP costs would be $11.0 million, as opposed to $7.71 million in the RTAL complex. This represents a savings of 30.1% compared to the cost of a fixed laboratory. This cost comparison does not include the significant savings achieved by project acceleration which depend on specific project circumstances.

Conclusions

The prototype Road Transportable Analytical Laboratory system was successfully demonstrated at the Fernald Environmental Management Project. This multi-modular integrated laboratory system was operated independently and continuously in the field through the unusually harsh winter of 1996. The prototype system was successful in demonstrating:

- Analytical performance equal to a well-run fixed laboratory
- Sample turnaround times 1/3 to 1/2 of FEMP's best times
- Analytical costs 30% less than fixed laboratory costs
- Major savings by accelerating remediation projects as a result of the rapid availability of high quality data on which to base critical decisions
- Additional savings by eliminating shipment charges for samples analyzed in the RTAL
- Ability to operate effectively and independently in the field under harsh environmental conditions
- Ability to move to new high priority projects, ensuring long-term utility

The capabilities of the Road Transportable Analytical Laboratory system integrate with those of fixed laboratories. The integration of RTALs into the DOE's analytical support network will minimize costs and maintain the DOE's ability to rapidly obtain high quality analytical data necessary for making critical project decisions.

RTAL systems will provide the DOE with significant time and cost savings, accelerating and improving the efficiency of clean-up and remediation operations throughout the DOE complex. When the RTAL is no longer needed for a specific project, the modules can be readily moved to support other high priority projects. This adaptability ensures the RTAL's future value in supporting the DOE's extensive remediation efforts.

Future Activities

The prototype RTAL system will remain at FEMP to support its high priority remediation projects. The design of the RTAL provides for modular changes in the analytical suite within each laboratory. This ensures that these laboratories maintain their state-of-the-art capabilities as improved analytical equipment becomes available. The high quality of the RTAL construction and the fine environmental control within the laboratories ensure their ability to generate data of the highest quality well into the future.

ECO provides the Road Transportable Analytical Laboratory System as a commercial off-the-shelf (COTS) product, providing full warranties and guarantees. ECO can provide RTAL systems on a sale or lease basis. ECO also provides maintenance and fully trained operating personnel to support RTAL operations. The RTAL system has been integrated into ECO's existing family of TERMM™ and Superfund TERMM™ modular transportable analytical laboratory and operational support systems. Discussions to provide RTAL systems at other DOE sites, e.g. Idaho, Rocky Flats, Savannah River and Hanford, have been initiated. In addition, application of the RTAL technology is under discussion for non-DOE sites with extensive hazardous waste contamination.

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